

C&EN

FEBRUARY 21, 1994

CHEMICAL COMPANIES FINALLY SAW EARNINGS INCREASE IN 1993 PAGE 10



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For fiscal 1995, Clinton stresses res
relevant to national needs Page 20

NEWS OF THE WEEK

■ Three former manufacturers of silicone breast implants have pledged more than \$4 billion to fund a proposed settlement plan to compensate women who claim their health has been compromised by the implants. **Page 4**

■ Persistent toxic substances released to the environment—such as chlorine and chlorinated organics—pose a serious risk and their use must be phased out, says the International Joint Commission, adding fuel to the ongoing debate over acceptable risk. **Page 5**

■ NIH decides not to appeal the Patent & Trademark Office's rejection of its application to patent thousands of fragments of human genes. **Page 5**

■ Moscow court sends back for review charges against Russian chemist of divulging state secrets, in what may be a prelude to dropping the case. **Page 6**

■ A laser-based technique for measuring carbon isotope ratios in gases that is simpler, more specific, and less expensive than the current process may broaden use of carbon-13 tracers as an analytical tool. **Page 6**

■ Space shuttle mission that conducted materials processing and biotechnology experiments is hailed as success despite some glitches. **Page 7**

BUSINESS

Recovery seems to be at hand for the U.S. chemical industry as major chemical companies finish 1993 with an earnings increase for the third straight quarter, ensuring a rise in earnings for all of 1993. **Page 10**

The outlook for Western Europe's petrochemical industry continues to be gloomy, weighed down by a plethora of problems, including overcapacity, high fragmentation, poor profitability, and increasing foreign competition. **Page 15**

More chemical companies and electric utilities are forming partnerships to supply energy services to the chemical firms' plants, providing the companies with the benefits of self-generation without the headaches. **Page 17**

SCIENCE/TECHNOLOGY

Total synthesis of the anticancer drug taxol is achieved by two independent groups using completely different strategies within six weeks of each other; but neither method appears to be of practical use for commercial production of the chemical. **Page 32**

Peroxo vanadium complexes have been found to have potent insulinlike activity, suggesting they could be orally active alternatives to injectable insulin. **Page 35**

AWARDS

The ACS Division of Biological Chemistry announces winners of the 1994 Repligen, Lilly, and Pfizer awards. **Page 37**

GOVERNMENT



Clinton's proposed budget for fiscal 1995, submitted to Congress on Feb. 7, calls for a slight increase in federal R&D spending and emphasizes areas selected by the Administration as national needs. **Page 20**

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LETTERS

Opinions on environmentalism

Bravo to Fred Tausch Jr. for his letter on the hazards of excessive environmentalism (C&EN, Jan. 31, page 5). He makes many valid points that should cause ACS to play a larger role in helping voters to distinguish between environmental science and environmental politics. However, Tausch fails to recognize that many ACS members rely on the environmental industry for their financial support and therefore have little incentive to bring a sense of moderation, balance, and truth to environmental issues. It is unlikely that ACS will respond the way he suggests because of this vocal constituency.

I strongly recommend that all ACS members read Michael Fumento's recent book "Science under Siege" (William Morrow & Co., New York, N.Y., 1993) for a chilling account of how the environmentalists have contrived to make the U.S. a third-rate nation by robbing us of technical advances and by obscuring the true cost to our economy of environmental overregulation.

Melvin H. Gitlitz
Berwyn, Pa.

Remarks in the letter by Fred Tausch Jr. deserve comment. Tausch would have ACS deal "with this [environmental] movement effectively" to return "good jobs at good pay for everyone" to the U.S. Not mentioned is the fact that those jobs depended in part on the acceptability of freely discarding waste materials into the air, water, and land. The implication is clear that ACS should advocate less restrictive waste discharges into the environment. I suggest that the opposite policy is more rational.

Accumulating human waste discards have already poisoned the global environment in visible ways. At present, environmental concentrations of lead and methyl mercury are demonstrated human hazards; DDT and dioxanes are suspect. Freons and carbon dioxide are below human toxicity levels but still are threatening to humans for other reasons. In addition, the same issue of C&EN brought news of a completely new environmental poison—accumulating estrogens.

It may seem surprising at first, but in the absence of humans, wastes generated by other life forms and discarded into the environment do not accumulate. It seems a general principle of nature that wastes may not accumulate in the biotic world.

That makes eminent good sense when one remembers that a sufficient accumulation of waste from any life form is poisonous to that life form and to others as well. The millions of species of flora, fauna, and microbiota living in the world interactively consume and transform the wastes of all species to jointly create a benign environment wherein all species escape the threat of extinction as a result of poisoning caused by wastes accumulated in the environment. This is the pivotal center of environmental concerns.

The corollary is that humans must do their part to maintain a benign environment or invite extinction—there is no intermediate choice. Humans, however, do not participate in the myriad intricate interdependent cycles of waste consumption and transformation in the biotic world; humans only generate and discard wastes into the environment. Fortunately, the biotic community has excess waste-transforming capacity that humans can use. Humans are actually parasitic on the remainder of the biotic community for waste transformation service.

Not only are humans dependent upon the biotic world for the food service essential to short-term survival, but also for the waste transformation service that is essential to long-term survival, a fact that we are just beginning to appreciate. The excess waste-transforming capacity in the nonhuman biotic world is a fact-of-life limitation on human activity.

Far from being a hazard to humanity, environmentalism seeks to preserve *Homo sapiens* from early extinction. ACS should endorse this goal rather than oppose it.

Carlyle Herrick
Environmental Consultant
Alphus, N.Y.

I read with great interest the letter by Fred Tausch Jr. about the hazard of environmentalism. His points regarding the misallocation of public funds and the politics surrounding the environmental movement are right on target. However, I resent his characterization of environmental compliance, regulation, and enforcement jobs as "adversarial, make-work" positions that eliminate "good jobs." Comments like these perpetuate the stereotype that the only "good" chemistry jobs are industrial or laboratory positions.

On the contrary, many chemists and chemical engineers find the environmental compliance field to be an excellent source of rewarding and challenging jobs. My

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Big Fourth-Quarter Earnings Increase Buoyed 1993 Results

William J. Storck,
C&EN Northeast News Bureau

Chemical company fortunes are finally beginning to pick up. After four straight years of decline for the chemical industry, recovery seems at last to be at hand. Between the end of 1988 and the final quarter of 1992, earnings from the 30 chemical companies regularly surveyed by C&EN had fallen a total of 38%. Now, however, they have started back with an estimated 8% rise for all of 1993. Certainly this does not bring them all the way back to what they once were, but it's a start.

When the year began, it did not look like 1993 would be any better than the

previous years. After all, earnings in the first quarter were still down from the comparable year-earlier period, extending a long string of declining results. However, in the second and third quarters, business began to pick up and chemical companies finished the year with a strong fourth-quarter performance. Earnings from 28 of the 30 regularly surveyed companies increased 36% in the final period. By press time, Stepan and Lubrizol had not yet reported fourth-quarter earnings, but when they do, their figures likely will make little difference in the overall rate of growth.

The 1993 earnings increase for chemical companies, while good, lagged the average percentage increase for oil com-

panies—10 companies surveyed showed an average increase of 27%. It was also behind the 22% average increase for nine diversified firms that are large producers of chemicals.

The percentage increase for chemical companies did beat that for a group of nine pharmaceutical firms, whose earnings rose an average of just 5%. However, many of these drug companies had unusual charges that could not be separated out.

While chemical companies did increase their earnings in the second and third quarters, it was the fourth quarter that seemed to be the true turning point if the recovery is sustained. The 36% increase in chemical company fourth-quarter earn-

Chemical industry leaders for fourth quarter . . .

Sales		
Rank 1993	\$ Millions	Rank 1992
1 Dow Chemical	\$4,505.0	1
2 Monsanto	1,882.0	2
3 W. R. Grace	1,192.0	3
4 Union Carbide	1,073.0	4
5 American Cyanamid	985.4	5
6 Arco Chemical	840.0	7
7 Air Products	827.3	6
8 Rohm and Haas	760.0	8
9 Hercules	714.7	9
10 Morton International	690.9	12

Earnings*		
	\$ Millions	Rank 1992
W. R. Grace	\$85.2	1
Dow Chemical	82.3	12
Air Products	75.1	2
Great Lakes Chemical	69.9	3
Arco Chemical	68.0	5
Hercules	58.3	6
Morton International	53.7	9
Monsanto	46.0	17
Union Carbide	44.0	15
Nalco Chemical	40.8	7

Profitability		
	Earnings as % of sales	Rank 1992
Great Lakes Chemical	15.7%	1
International Flavors	13.7	2
Nalco Chemical	11.7	5
Loctite	9.7	3
Air Products	9.1	6
Betz Laboratories	9.0	4
Crompton & Knowles	8.8	7
Hercules	8.2	13
Arco Chemical	8.1	10
Imcera	7.9	8

. . . and for full-year 1993

Sales		
Rank 1993	\$ Millions	Rank 1992
1 Dow Chemical	\$18,060.0	1
2 Monsanto	7,902.0	2
3 Union Carbide	4,640.0	3
4 W. R. Grace	4,408.4	4
5 American Cyanamid	4,276.8	5
6 Air Products	3,341.5	6
7 Rohm and Haas	3,269.0	8
8 Arco Chemical	3,192.0	7
9 Hercules	2,800.0	9
10 Morton International	2,539.0	12

Earnings*		
	\$ Millions	Rank 1992
Dow Chemical	\$552.7	1
Monsanto	460.0	3
American Cyanamid	348.1	2
Air Products	280.8	4
Great Lakes Chemical	272.8	5
W. R. Grace	234.4	7
Arco Chemical	214.0	8
Hercules	208.4	10
International Flavors	202.5	9
Morton International	185.5	12

Profitability		
	Earnings as % of sales	Rank 1992
International Flavors	17.0%	1
Great Lakes Chemical	14.9	2
Loctite	11.1	3
Nalco Chemical	11.0	5
Betz Laboratories	10.7	4
Crompton & Knowles	9.3	6
Air Products	8.4	6
American Cyanamid	8.1	8
Imcera	7.8	9
Hercules	7.4	14

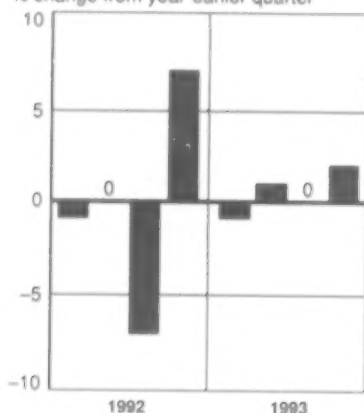
Note: Based on 30 chemical companies listed on page 12. * After taxes.

Chemical industry 1993 fourth-quarter results

- Sales increased 2%
- Earnings climbed 36%
- Profitability was 4.8%
- Output rose 2.0%
- Prices up slightly

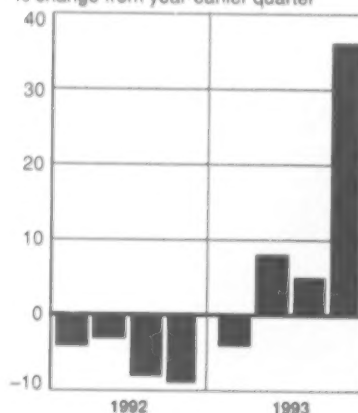
Sales

% change from year-earlier quarter



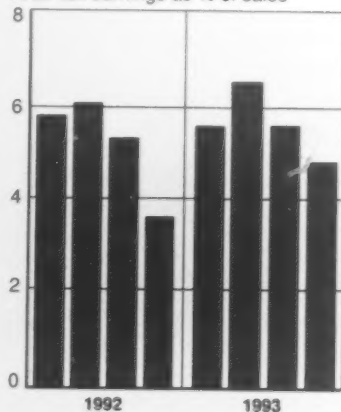
Earnings

% change from year-earlier quarter



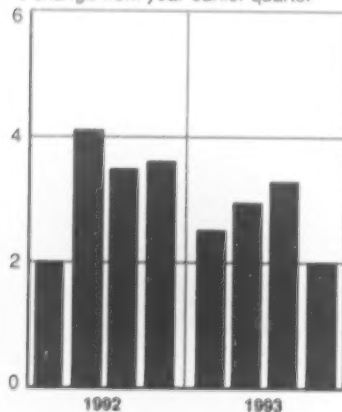
Profit margins

After-tax earnings as % of sales



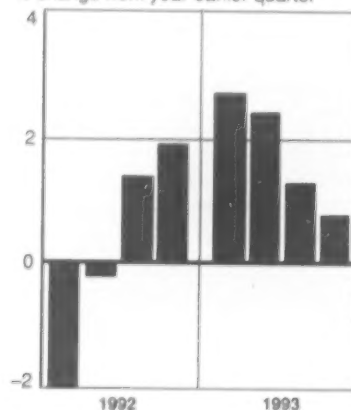
Production

% change from year-earlier quarter



Prices

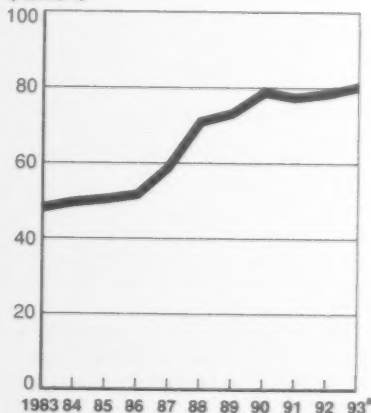
% change from year-earlier quarter



In 1993, sales pushed past \$80 billion while earnings rose to almost \$5 billion, driving profit margins higher

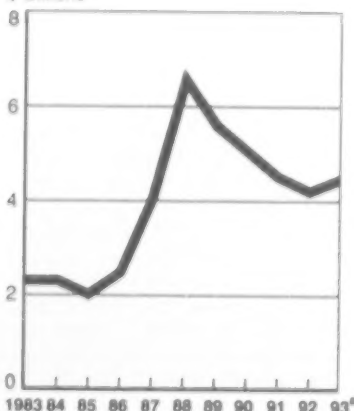
Annual sales

\$ Billions



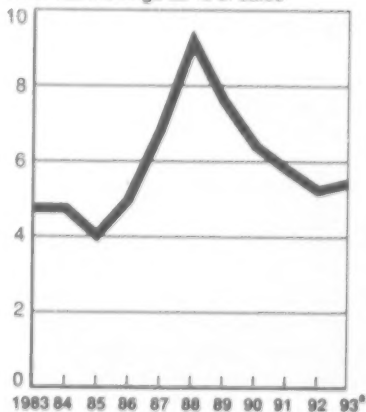
Annual earnings

\$ Billions



Annual profit margins

After-tax earnings as % of sales



Note: All sales, earnings, and profit margin data are based on 30 chemical companies listed on page 12. * C&EN estimates for all 30 companies.

Chemical company earnings increased for both fourth quarter and full year

	FOURTH-QUARTER 1993						FULL-YEAR 1993					
	Sales		Earnings ^a		Change from 1992		Profit margin ^b		Sales		Earnings ^a	
	(\$ millions)		Sales		Earnings		1993 1992		(\$ millions)		Change from 1992	
Air Products	\$ 827.3	\$ 75.1	2%	9%	9.1%	8.5%			\$ 3,341.5	\$ 280.8	2%	2%
American Cyanamid	985.4	40.1	3	-32	4.1	6.1			4,276.8	348.1	2	0
Arco Chemical	840.0	68.0	8	42	8.1	6.2			3,192.0	214.0	3	10
Betz Laboratories	168.4	15.2	-2	-24	9.0	11.6			684.9	73.1	-3	-11
Cabot	398.5	15.1	1	37	3.8	2.8			1,616.8	62.9	3	11
Crompton & Knowles	142.9	12.5	4	20	8.8	7.6			558.3	52.0	8	20
Dow Chemical	4,505.0	82.3	-5	202	1.8	0.6			18,060.0	552.7	-5	1
Ethyl	486.7	17.9	4	4	3.7	3.7			1,936.4	107.0	15	29
First Mississippi	115.9	3.1	11	def	2.6	def			457.3	5.7	-4	25
H. B. Fuller	247.8	6.9	1	-25	2.8	3.7			975.3	21.7	3	-39
Georgia Gulf	192.2	10.5	-3	17	5.5	4.6			768.9	42.2	-1	-9
BF Goodrich	488.3	1.9	22	-54	0.4	1.0			1,818.3	23.6	10	28
W. R. Grace	1,192.0	85.2	-2	15	7.1	6.1			4,408.4	234.4	2	16
Great Lakes Chemical	444.2	69.9	6	15	15.7	14.5			1,827.8	272.8	19	17
Hercules	714.7	58.3	3	39	8.2	6.0			2,800.0	208.4	-3	24
IMC Fertilizer	329.0	-3.6	67	def	def	1.5			1,074.1	-38.6 ^c	11	def
Imcera	466.3	36.7	6	31	7.9	6.3			1,849.5	144.9	5	11
International Flavors	259.6	35.7	2	2	13.7	13.8			1,188.6	202.5	6	7
Loctite	152.2	14.8	4	-23	9.7	13.1			612.6	68.3	1	-5
Lubrizol	na	na	na	na	na	4.7			na	na	na	na
Monsanto	1,882.0	46.0	1	283	2.4	0.6			7,902.0	460.0	2	33
Morton International	690.9	53.7	27	57	7.8	6.3			2,539.0	185.5	18	28
Nalco Chemical	348.9	40.8	-3	0	11.7	11.4			1,389.4	152.7	1	5
Olin	598.4	9.2	8	171	1.5	0.6			2,422.6	40.2	2	-26
Petrolite	93.1	5.3	16	13	5.7	5.9			351.8	20.5	11	25
Praxair	613.0	40.0	-4	def	6.5	def			2,438.0	143.0	-6	15
Rohm and Haas	760.0	26.0	1	-10	3.4	3.8			3,269.0	181.0	7	-14
Stepan	na	na	na	na	na	4.1			na	na	na	na
Union Carbide	1,073.0	44.0	-10	132	4.1 ^d	1.6			4,640.0	165.0	-5	39
Witco	499.3	26.8	9	136	5.4	2.5			2,142.6	87.5	24	30
TOTAL^d	\$19,514.8	\$937.4	2%	36%	4.8%	3.6%			\$78,543.8	\$4,311.7	2%	8%

^a Earnings from continuing operations, excluding significant nonrecurring and extraordinary items. ^b Earnings as a percentage of sales. ^c Includes nonrecurring items. ^d For 28 companies reporting. **def** = deficit. **na** = not available.

ings, to a total of \$937 million, came on an average sales increase of just 2% to \$19.5 billion. This pushed up the aggregate profit margin for the group to 4.8% in the quarter from 3.6% in the fourth quarter a year earlier.

Perhaps the more important measure is the spread between growth in earnings and growth in sales. With sales increasing only 2% compared with the 36% increase in earnings from continuing operations, excluding major nonrecurring and extraordinary items, indications are clear that cost cutting has worked.

A good example of this was at Dow Chemical, where fourth-quarter earnings more than tripled to \$82.3 million on a 5% decline in sales to about \$4.51 billion

Ground rules for C&EN earnings analysis

C&EN's quarterly report on financial performance of the U.S. chemical industry contains data from the 30 largest U.S. basic chemical companies and from 19 oil and diversified companies, each with more than \$200 million in annual chemical sales, plus nine pharmaceutical companies.

To be included in the table of basic chemical companies, a company must have at least 50% of its sales in chemicals. That is why DuPont, for example, is included in the table of diversified manufacturers.

In referring to chemical sales, C&EN means sales of those chemicals whose molecular composition has been changed in the course of manufacture. Hence, chemical sales include those of traditional categories of basic petrochemicals and inorganics, organic intermediates and inorganic compounds, polymers such as plastics and fibers, and agricultural chemicals and specialty derivatives.

In listing earnings, the report gives after-tax income for continuing operations before nonrecurring items and extraordinary charges. Foreign currency translations are included.

Earnings rose for oil, diversified, and drug companies in 1993

	FOURTH-QUARTER 1993						FULL-YEAR 1993					
	Sales	Earnings ^a	Change from 1992		Profit margin ^b		Sales	Earnings ^a	Change from 1992		Profit margin ^b	
	(\$ millions)		Sales	Earnings	1993	1992	(\$ millions)		Sales	Earnings	1993	1992
OIL AND GAS COMPANIES												
Amoco	\$ 7,328.0	\$ 464.0	1%	-15%	6.3%	7.6%	\$ 28,622.0	\$ 1,740.0	1%	18%	6.1%	5.2%
Ashland	2,571.6	58.4	1	136	2.3	1.0	9,899.1	149.0	0	262	1.5	0.4
Chevron	8,900.0	515.0	-17	-5	5.8	5.1	37,100.0	2,148.0	-7	38	5.8	3.9
Exxon	27,843.0	1,500.0	-10	7	5.4	4.5	110,977.0	5,280.0	-5	11	4.8	4.1
Mobil	16,859.0	602.0	-4	3	3.6	3.3	64,035.0	2,224.0	-1	49	3.5	2.3
Occidental Petroleum	2,020.0	17.0	-13	21	0.8	0.6	8,116.0	74.0	-4	-41	0.9	1.5
Phillips Petroleum	2,990.0	-33.0	-5	def	def	4.6	12,545.0	217.0	3	21	1.7	1.5
Shell Oil	5,155.0	152.0	-8	114	2.9	1.3	21,092.0	781.0	-3	76	3.7	2.1
Sun Co.	2,290.0	55.0	-14	67	2.4	1.2	9,417.0	193.0	-12	543	2.0	0.3
Unocal	1,965.0	70.0	-20	-23	3.6	3.7	8,344.0	347.0	-17	48	4.2	2.3
TOTAL	\$77,921.6	\$3,400.4	-8%	-1%	4.4%	4.1%	\$310,147.1	\$13,153.0	-4%	27%	4.2%	3.2%
DIVERSIFIED MANUFACTURERS												
AlliedSignal	\$ 3,059.0	\$ 178.0	0%	24%	5.8%	4.7%	\$ 11,827.0	\$ 658.0	-2%	22%	5.6%	4.5%
DuPont	9,251.0	329.0	1	96	3.6	1.8	37,098.0	1,953.0	-2	50	5.3	3.4
Eastman Kodak	4,480.0	204.0	0	-19	4.6	5.6	16,364.0	475.0	-1	-35	2.9	4.4
Engelhard	539.4	30.2	-1	8	5.6	5.1	2,150.9	102.2	-10	2	4.8	4.2
Ferro Corp.	265.3	15.8	2	-3	6.0	6.3	1,065.7	57.5	-3	-2	5.4	5.4
FMC	946.5	20.7	-6	-34	2.2	3.1	3,753.9	164.0	-6	-15	4.4	4.8
PPG Industries	1,378.2	98.1	-2	44	7.1	4.8	5,753.9	301.1	-1	-6	5.2	5.5
Tenneco	3,376.0	150.0	2	417	4.4	0.9	13,255.0	451.0	1	182	3.4	1.2
Vulcan Materials	282.0	20.6	4	1	7.3	7.5	1,133.5	88.2	5	-3	7.8	8.4
TOTAL	\$23,577.3	\$1,046.4	0%	38%	4.4%	3.2%	\$ 92,401.9	\$ 4,250.0	-2%	22%	4.6%	3.7%
PHARMACEUTICAL COMPANIES												
Abbott Laboratories	\$ 2,228.0	\$ 391.3	6%	12%	17.6%	16.6%	\$ 8,407.8	\$ 1,399.1	7%	13%	16.6%	15.8%
American Home Products	2,116.3	382.7	6	6	18.1	18.1	8,304.9	1,469.3	5	28	17.7	14.6
Bristol-Myers Squibb	2,992.8	565.8	6	7	18.9	18.7	11,412.7	2,269.1	2	8	19.9	18.9
Eli Lilly	1,800.8	332.4	9	7	18.5	18.8	6,452.4	1,347.1	5	63	20.9	13.4
Merck	3,000.8	674.2	15	11	22.5	23.4	10,498.2	2,166.2	9	-11	20.6	25.3
Pfizer	1,989.2	288.9	2	4	14.5	14.3	7,477.7	657.5	3	-40	8.8	15.1
Schering-Plough	1,066.4	188.9	7	13	17.7	16.9	4,341.3	825.0	7	15	19.0	17.8
Upjohn	926.3	155.9	-4	2	16.8	15.8	3,611.2	585.5	2	5	16.2	15.8
Warner Lambert	1,533.8	118.5	4	-14	7.7	9.3	5,793.7	645.0	4	0	11.1	11.5
TOTAL	\$17,654.5	\$3,098.6	7%	7%	17.6%	17.5%	\$ 66,299.9	\$11,363.9	5%	5%	17.1%	17.1%

^a Earnings from continuing operations, excluding significant nonrecurring and extraordinary items where possible. ^b After-tax earnings as a percentage of sales. **def** = deficit

and where earnings for the year were up just 1% to \$553 million, again on a 5% decline in sales to \$18.1 billion. "Improved productivity in the fourth quarter and throughout 1993 compensated for the profit impact of lower sales," says Frank Popoff, the company's chairman and chief executive officer. "Interest rate management, reduced debt, and work process improvements helped us cut our net interest expense and research, promotion, selling, and administrative expenses by more than \$400 million in 1993 compared to 1992. In addition, our

capital spending and manufacturing costs were all lower in 1993. We will continue to make progress in this effort."

Union Carbide, whose earnings were up 132% for the quarter to \$44 million and up 39% for the year to \$165 million, tells pretty much the same tale. Robert D. Kennedy, Carbide's chairman and chief executive officer, says, "Earnings benefited from our cost reduction efforts, despite the continued worldwide downturn in the chemical industry. At the end of 1993, Carbide already had achieved more than \$400 million in cost reduc-

tions and we are well on our way toward reaching our goal by the end of 1994. Continued attention to maintenance, inventory control, production and distribution activities, as well as the conclusion of streamlining activities in our corporate staff, information technology, finance, and engineering groups, should get us to our objective of a \$575 million rate of savings by year's end."

And the cost cutting is not going to end at many companies. For instance, at W. R. Grace, president and chief executive officer J. P. Bolduc says, "The entire

Chemical earnings improve at most oil companies

If you want to know the state of petrochemicals, one of the best places to look is the chemical operations of oil companies. Made up largely of the big-volume organic building blocks of the chemical industry, the financial results of these operations tell more about the chemical economy than perhaps any other segment.

What these results are saying is that chemicals are helping oil companies to greatly varying degrees, but overall, petrochemicals are much stronger than they have been in some time.

For a group of eight oil companies with large chemical operations, these units delivered \$331 million in earnings in the fourth quarter, up more than 600% from the same period in 1992. And for the full-year 1993, the \$1.24 billion or so in earnings was almost double those in 1992.

Exxon, which has the biggest chemical operations of the oil companies, had earnings of \$133 million from chemical operations in the fourth quarter, up 138% from the same period in 1992. But for the full year, its chemical earnings were down 9% to \$410 million. The company says that in the fourth quarter, earnings from worldwide chemical operations benefited from lower operating

expenses and increased sales of higher margin products despite excess industry capacity and weak economic conditions in many markets.

The same was true at Amoco, which boasted a more than fourfold increase in quarterly earnings to \$83 million—higher sales volumes and margins in certain product lines and benefits associated with restructuring and cost-reduction efforts.

Shell Oil, which went from a \$53 million loss in fourth-quarter 1992 to earnings of \$67 million in fourth-

quarter 1993, credited increased sales volumes of polymers and lower feedstock costs for commodity chemicals.

Not every company posted an earnings increase, however. Chevron, which went from a small \$4 million profit in the fourth quarter of 1992 to an \$8 million loss in 1993's fourth quarter, says the chemical results reflect the depressed state of the petrochemicals industry and especially that of olefins. Industry overcapacity and weak worldwide economies have held down product prices.

\$ Millions	EARNINGS ON CHEMICAL OPERATIONS					
	Fourth quarter			Full year		
	1993	1992	% change	1993	1992	% change
Amoco	\$ 83	\$ 18	361%	\$ 240	\$-94	nm
Chevron	-8	4	nm	31	36	-14%
Exxon	133	56	138	410	451	-9
Mobil	1	4	-75	44	73	-40
Occidental	16	6	167	173	99	75
Phillips	30	10	200	75	41	83
Shell	67	-53	nm	220	12	1,733
Unocal	9	0	nm	43	23	87
TOTAL	\$331	\$ 45	636%	\$1,236	\$641	93%

nm = not meaningful.

organization is focused on improving our results in 1994. We will accomplish this through continuously improving how we operate—by moving faster into new global markets, reducing costs, introducing new products, and allocating resources only to those areas where returns will exceed the company's cost of capital."

It almost had to be cost cutting that boosted earnings in the fourth quarter, because many of the basic economic indicators of the chemical economy just didn't show that much life. For instance, prices were up less than 1% for chemicals and allied products in the quarter and production rose only about 2%.

Shipments of chemicals and allied products in the fourth quarter increased 4% over the same period the year before—about the same rate they increased for the entire year. And shipments of industrial chemicals, up 1.7% in the quarter, registered lower growth than the 2.9% seen for the year as a whole.

Prices were on the minds of many chemical company executives, among them J. Lawrence Wilson, chairman and chief executive at Rohm and Haas. Wil-

son says: "We are pleased with our volume growth during tough economic times, but we are not happy with the results that pricing pressures and currency movements brought to the bottom line. We expect better earnings in 1994, but until European and Japanese economies recover and our internal cost-reduction measures are fully implemented, we do not expect the dramatic earnings improvement recorded during previous economic recoveries."

As evidenced by Wilson's comments, foreign markets and their economic problems are still very much on the minds of industry executives. At Cabot Corp., chairman and chief executive officer Samuel W. Bodman says: "Our income continues to benefit from worldwide cost reduction efforts but we remain concerned that the European and Japanese economies are still quite sluggish."

At DuPont, chairman Edgar S. Woolard notes that chemicals and specialties businesses benefited from lower costs, "but this was mitigated somewhat by weak economic conditions in Europe." Woolard adds, "We will continue with

strong efforts to improve productivity and raise revenues, so that our businesses grow faster than the growth anticipated in global economies."

Despite the problems in pricing, demand, and foreign economies, many chemical producers are optimistic about what lies ahead. Perhaps the most sanguine is Witco's chairman and chief executive officer, William R. Toller. "We are starting 1994 with an optimistic outlook and great enthusiasm as we aggressively operate in a marketplace with our new structure in place. In 1993, all segments of our business performed well in a tough economic environment, including in Europe. We made satisfying progress in meeting our goals of international expansion, increasing dividends, and concentration of our resources on core businesses as our divestment plans moved forward."

Much of what Toller says can be said for most of the U.S. chemical industry. With that in mind, barring any major economic dislocation, most chemical executives agree that 1994 seems to be looking better than any year in the recent past. □

Europe's petrochemical outlook remains bleak

The problems of Western Europe's petrochemical industry—overcapacity, high fragmentation, bleak profitability, increasing foreign competition—continue to point to a bleak outlook. Indeed, according to Roger C. M. Longley, a director for consultant Chem Systems Ltd., London, recent efforts to resolve some of the industry's structural problems in Western Europe have fizzled out, leaving companies facing ever tougher decisions on their own.

Speaking at the consulting firm's annual seminar on petroleum and petrochemical economics, held in London, Longley said that petrochemical companies' problems must be solved by internal actions, not by reliance on a general economic upturn. An upturn may help, but it will be no cure-all.

The chemical industry goes through cycles dependent upon those of the general economy, he points out. But cyclic behavior hides the underlying problems.

"It distorts or conceals creeping uncompetitiveness and failing to invest in key businesses. A business only stays profitable if costs are continuously reduced to match market performance, and costs, rather than capacity issues, should drive restructuring in the sector."

Given the West European industry's relatively high cost structure, there is no particularly compelling case for the region to be an expanding area for ethylene derivatives. Nor will the next few years' worth of demand come from the area.

Total global ethylene demand is forecast to grow from 62 million metric tons in 1992 to 89 million metric tons by 2000, while total global capacity for ethylene production will reach 99 million metric tons worldwide by the end of the decade, according to consultant Martin Rock, also with Chem Systems. However, demand in Western Europe is expected to grow more slowly, from 16 million metric tons in 1992 to 19 million metric tons in 2000.

This means that the industry will continue to face structural problems requiring urgent actions—actions that should be taken but which are hampered by other factors.

Among these problems are the effects of company culture, Longley says. For example, a company might need to cut capacity or even get out of a nonstrategic business, but may procrastinate because of sentimental attachment to the activity or because of a "we invented it" attitude. And if the chemicals culture gets out of sync with that of a parent, other problems arise. Chem Systems, he says, is seeing more "dissatisfaction of oil companies with their petrochemical subsidiaries. This goes beyond short-term dissatisfaction with results: it is becoming a great cultural divide between 'group' and 'chemicals' cultures."

He also cites financial constraints hindering positive action. "Diversified companies must allocate funds to the part of their portfolios that they see as most deserving, which may make it impossible to fulfill a petrochemical strategy that is opti-

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Monday, December 19

Heinz Staab, Heidelberg. "From Paracyclophanes to

Photosynthesis Models"
Masashi Tashiro, Kyushu University. "Synthesis and

Chemistry of [2.2]metacyclophanes"

Emanuel Vogel, University Köln. "From 1,6-

Methanol[10]annulene to Metalloporphyrinoids"

Peter Vollhardt, UC-Berkeley. "The Phenyls: A

Testing Ground for the Origin of Delocalization in Benzene"

Horst Prinzbach, University Freiburg. "New Aspects in

the Chemistry of Hydrocarbon Cages"

Leo Paquette, Ohio State Univ. "Unleashing the Synthetic

Potential of Strained Ring Systems"

Francois Diederich, ETH. "Synthetic Molecular and

Polymetric Allotropes of Carbon"

G. K. Surya Prakash, USC. "Functionalizing

Hydrocarbons with Fullerenes"

Tuesday, December 20

Armin de Meijere, Georg-August-U. Göttingen. "Small

Rings Galore: New Star and Cage Hydrocarbons"

Teruaki Mukaiyama, Science University, Tokyo.

"Oxygenation of Olefins with Molecular Oxygen"

Robert Muriarty, University Illinois, Chicago.

"Hypervalent Iodine Syntheses in the Cubyl System"

Peter Stang, University Utah. "Bis-Cyclopentenes,

Cyclopentenones and Conjugated Enynes via Iodonium

Chemistry"

Lawrence Scott, Boston College. "Novel Syntheses

and Reactions of Polycyclic Aromatic Hydrocarbons at

Inordinately High Temperatures"

Mordecai Rabinovitz, Hebrew University. "The

Spatial Structure of Polycyclic Carbanions"

Clarence Chang, Mobil, NJ. "Influence of Intrazeolitic

Environment on Electrophilic Aromatic Substitutions"

Jule Rabe, UOP, Ill. "The Role of Structure in Acid

Function of Zeolites: Effecting Hydrocarbon Transformations"

George A. Olah, USC & Dale Williams, Texaco,

Houston. "Modified HF Catalyzed Environmentally Safe

Isobutane-Isobutylene Alkylation"

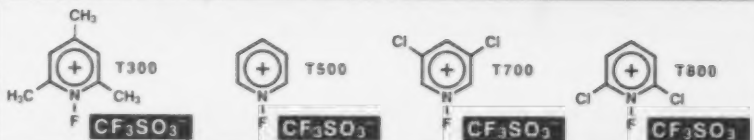
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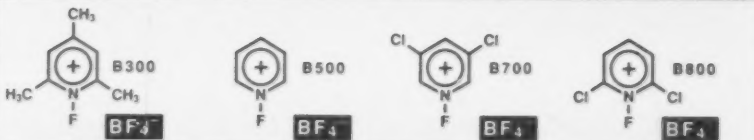
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mum on a stand-alone basis. Countercyclical investment is very rarely made because of this and is made worse by short-term views in a business that ideally needs a 10-year investment cycle." Furthermore, companies contemplating joint ventures know that they lose ownership of assets and control of cash flow, which may damage their financial ratios, so they may elect not to enter the venture.

The industry can change, however: Witness the revitalization of industry segments in the U.S. because of investors Lord Hanson, Jon M. Huntsman, and Gordon A. Cain. "There are some signs that restructuring in Europe will bring in some different management styles," Longley predicts.

One reason Western European oil companies may be dissatisfied with their petrochemical operations, suggests Chris Brown, a Chem Systems senior consultant, is because refiners faced many of the same problems that petrochemical producers did early in the 1980s, but made difficult and painful decisions to restructure that have paid off.

Middle East, Asia will lead growth in ethylene demand

Millions of metric tons	1992	1995	2000	% annual change 1992-2000
Western Europe	16	17	19	2.2%
North America	21	23	26	2.7
Eastern Europe	6	7	10	6.6
Middle East/Africa	3	4	8	13.0
Latin America	3	4	5	6.6
Japan	6	7	7	1.9
East Asia/Oceania	7	9	14	9.1
TOTAL	62	71	89	4.6%

Source: Chem Systems Ltd

Brown contends that European refiners have led the world in trying to correct overcapacity and poor profitability. The number of refineries dropped to just over 100 in 1993 from about 150 in 1980, with a typical staffing level of about 500 employees today, compared with staffing levels that frequently were well over 1,000 per refinery in the 1980s.

What's more, he and Longley agree, refiners have managed to be relatively profitable into the 1990s. Petrochemical operating rates now are roughly the same as refinery operating rates, Longley points out. "But refiners can make money at those rates, and petrochemicals can't," he says. An operating rate of 88% in petrochemicals means the most inefficient producers are sustaining losses, and the most efficient are barely breaking even. In contrast, at the same rates, the least efficient refiners are breaking even, and the most efficient are getting a good return.

Despite the disenchantment of oil companies with their chemical operations, benefits of oil refinery/petrochemical integration do exist, Brown notes. "You can quantify integration benefits for petrochemicals of about \$70 per [metric] ton of ethylene; there are similar benefits for refiners."

Patricia Layman

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Clinton's 1995 Budget Proposal Calls for Increases in R&D Funding

**But in a tightly constrained budget, the focus is on research
that addresses national goals**

David J. Hanson, Bette Hileman, Wil Lepkowski, Janice R. Long, and Pamela S. Zurer, C&EN Washington

The first reduction in federal discretionary spending that almost anyone can remember, and a \$58 billion reduction (at least on paper) in the federal deficit are the hallmarks of the fiscal 1995 budget that President Bill Clinton submitted to Congress on Feb. 7.

Nevertheless, the budget proposals call for a 3% rise to \$73 billion in total federal R&D spending, which fell 2% from 1993 to 1994. The Clinton Administration had less than three months to prepare its first budget, which was submitted to Congress in early April of last year. It's had a year to work on the 1995 proposal, and it shows.

In line with Clinton's emphasis on research that will benefit both the quality of life in the U.S. and the nation's competitive position, funding for applied R&D would rise 4% to \$56.9 billion in fiscal 1995, following a 3% decline in the current fiscal year. Funding for basic research would increase 2% to \$14.1 billion, on the heels of a 3% rise in fiscal 1994. Funding for R&D facilities would drop once again, down 22% to \$2.0 billion.

This budget may mark the end of the tug-of-war between so-called big and little science. Missing from its pages is any funding—except money for shutdown—for the Supercon-

ducting Super Collider, which Congress killed last year, and funding for the space station is essentially frozen at about \$2 billion.

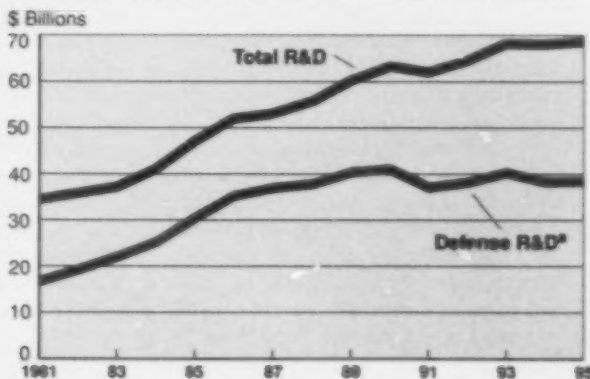
The R&D part of the Administration's budget proposal drew a wide variety of responses. Two examples:

Rep. George E. Brown Jr. (D-Calif.), chairman of the House Committee on Science, Space & Technology, says, "The good news on deficit reduction heralds tough times ahead for the nation's R&D investment. The stringency of the budget caps has seriously squeezed funding for a number of worthwhile science programs in fiscal 1995, and the long-term outlook for many science and R&D budgets is very grim." Brown's committee has budget authority over all R&D programs except those carried out by the departments of Agriculture, Defense, and Health & Human Services.

On the other hand, Cornelius Pings, president of the American Association of Universities (AAU), says: "I think we have to be very pleased with the proposed increases in the research budget given what's going on in the federal arena, with some departments and agencies actually facing cuts. Sure, we could use more, but on balance this is very good news."

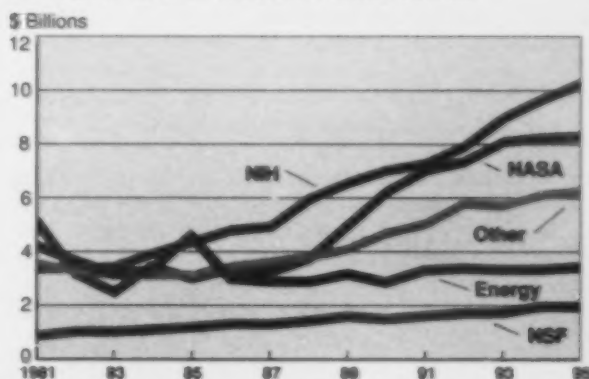
AAU's members, however, are troubled by the President's proposal to seek a "pause" in indirect cost payments to universities and other research institutions in fiscal 1995. Under the suggested plan, the dollar amount each university re-

Despite end of Cold War, defense still consumes over 55% of total R&D funds ...



Note: Outlays. Funding for R&D facilities not included. * Includes military-related programs of the departments of Defense and Energy. Source: Office of Management & Budget

... while NIH continues to account for over 30% of nondefense R&D funds



Fiscal 1995 federal R&D budget increases 3%...

\$ Millions	1993 ^a	1994 ^a	1995 ^b	% change 1994-95
BY AGENCY^c				
DOD	\$36,971	\$35,538	\$38,617	4%
Health & Human Services	11,484	11,033	10,336	4
NASA	8,597	8,493	8,090	1
Energy	6,052	6,054	5,827	0
NSF	2,220	2,026	1,882	10
Agriculture	1,394	1,393	1,335	0
Commerce	1,204	919	667	31
Transportation	692	617	578	12
EPA	582	536	508	9
Other agencies	1,833	1,876	1,910	-2
BY FUNCTION				
Conduct of R&D	71,029	68,484	69,750	4
Applied R&D	56,917	54,693	56,388	4
Defense ^d	38,296	36,923	40,004	4
Civilian	18,621	17,770	16,384	5
Basic research	14,112	13,790	13,362	2
Civilian	12,880	12,578	11,951	2
Defense ^d	1,232	1,212	1,411	2
R&D Facilities	2,016	2,589	2,728	-22
TOTAL	\$73,045	\$71,072	\$72,478	3%

... and emphasizes high-priority, 'strategic' investments

\$ Millions	1993 ^a	1994 ^a	1995 ^b	% change 1994-95
University research support	\$12,156	\$11,719	\$11,674	4%
International space station	2,121	2,104	2,262	1
Dual-use technology	2,148	2,011	1,705	7
Manufacturing technology extension programs	2,061	1,871	18	10
Global-change research	1,794	1,446	1,338	24
Transportation research	1,180	944	655	25
High-performance computing & communications	1,154	938	772	23
Technology transfer	865	551	384	57
Human genome project	241	199	169	21

Note: Budget authority. Strategic items contain double counting (they should not be summed), reflecting the leveraged nature of these investments. ^a Estimate. ^b Actual. ^c Does not include facility funding. ^d Includes military-related R&D programs of the departments of Defense and Energy. Source: Office of Management & Budget.

ceives for overhead reimbursements would be capped at the level they recoup in fiscal 1994.

"Pause" is an interesting euphemism," Pings says. "It's not really a saving but a shifting of costs to universities. It's an unfortunate proposal whose full impact has not been worked out. It has the curious feature of punishing success: Funds will be denied to those who are successful in increasing their research base."

Pings points out that a substantial fraction of indirect cost reimbursements pays for research facilities, many of which are in critical need of upgrading. "We haven't been successful in conveying that we can't simply do research out on the lawn," he says. "I suspect the policy is going to erode what little discretionary funding universities have, most of which now goes to get new faculty started."

AAU plans to oppose the proposal, Pings says. The organization will try to convince Congress' appropriations committees that the policy will impose hardships on universities while creating new bureaucracies both in government and on campus.

In the following sections, C&EN provides a closer look at the budgets proposed for most of the various federal agencies that support research, particularly chemical research, activities.

National Science Foundation. With a 6% increase over its \$3.0 billion total for fiscal 1994, NSF has no reason at all to complain about the treatment given it by the Clinton Administration. The Administration has said all along that its policy is to protect basic science. So the rise to a total of \$3.2 billion really comes as no surprise to budget watchers. "A very good budget, in a very tough budget year," is how NSF director Neal F. Lane put it in his briefing to the press on Feb. 7.

NSF's keyword this year is "strategic," and its aim—mandated by Congress—is to place 60% of its research program under that rubric. Thus, it stresses the strategic areas of advanced manufacturing technology; advanced materials processing; biotechnology; environmental research; global-change research; high-performance computing and communications; and science, math, engineering, and technology education. Together they amount to \$2.11 billion.

The total can be misleading, however, because the categories overlap. Advanced manufacturing technology, for example, can have a substantial biotechnology component; high-performance computing is applicable to the modeling and instrumentation challenges of global-change research.

Chemistry is one of the divisions benefiting from NSF's focus on strategic initiatives (C&EN, Feb. 7, page 16). Just before the proposed 1995 budget was announced, the division received an additional \$2 million for fiscal 1994 for environmental chemistry programs. That extra money, which was shifted from other divisions within the Mathematical & Physical Sciences (MPS) Directorate, increased the chemistry division's budget for 1994 to \$121 million.

The division's proposed budget for fiscal 1995 would increase 7% to \$130 million. All of the \$6.5 million increase for research is targeted toward strategic research areas, says acting division director John B. Hunt, including an additional \$2 million for advanced manufacturing research and \$3 million for environmental chemistry, which includes global-change research.

"We may have trouble identifying enough proposals in environmental chemistry to spend the money," Hunt told a recent gathering of government staff from agencies that fund chemical research. "We're a little bit uncomfortable, but it's a kind of discomfort I bet most of you would like to have."

NSF's only decrease would come in the highly political category of bricks and mortar—or academic research infrastructure. The subject has been debated for years, with Congress usually appropriating increases and the executive branch refusing them. Last year, NSF asked for \$55 million, but Congress appropriated \$100 million. For fiscal 1995, NSF is once

again asking for \$55 million. Lane says he knows the infrastructure needs of universities are critical, but that research funds are more important and that the Administration is looking deeply into some long-term solutions to the problem. Nothing new about that.

One of the peculiarities of NSF's budget is the outsized increase in funding for global-change research. That figure would rise from an already substantial \$142 million to almost \$208 million. High-performance computing and communications, another big NSF initiative, would rise more modestly but still impressively, from \$267 million to \$329 million. Environmental research is another major NSF winner, rising 8% from \$144 million to \$156 million.

Why should those areas deserve a much larger increase than, say, biotechnology or social and behavioral research? Washington policy observers say the answer is simple: They are Vice President Al Gore's favorite subjects. Even the seemingly substantial 15% rise in social behavioral science—from \$70.6 million to \$84 million—largely goes for studies related to the social impact of global change.

Funding for science and math education, which has grown like crazy over the years at NSF, virtually levels off—rising only 3% to \$586 million. Lane says it's time to pause and take a look at how well the many programs within that activity are working out. Another sector that NSF has stressed in recent years is the engineering and science and technology research centers. However, the total funding remains about the same (\$110 million to \$111 million) so no new projects will be funded unless some existing ones are not renewed.

National Institutes of Health. The President's budget for fiscal 1995 includes \$11.5 billion dollars for NIH, an increase of over \$500 million, 5% more than the current fiscal year. That's not nearly as high as many in the biomedical research community would like—the Federation of American Societies of Experimental Biology, for example, had recommended a 9% raise for NIH—but it is a respectable showing in light of the pressures on the federal budget.

In the competition for funding, NIH benefits from the clear links between its programs and improvements in human health. "Basic science research and other research in NIH are very much a part of the President's plan for health care reform," says Donna E. Shalala, Secretary of the Department of Health & Human Services (HHS). "Included in our definition of prevention is our investment in NIH and basic sciences in general."

Shalala also credits NIH director Harold E. Varmus with the relative success of the NIH budget. "The extraordinary leader we've attracted to NIH is keeping everyone's feet to the fire," she says.

As with other federal agencies, a growing part of NIH's portfolio is being focused on areas the budget calls strategic or high need. More than \$2 billion of NIH's proposed budget is targeted at AIDS, breast cancer and other women's health research, the human genome project, minority health, tuberculosis, and high-performance computing.

AIDS research at NIH would increase 6% over the fiscal 1994 level to \$1.4 billion. For the first time, funding for AIDS research at NIH is not being assigned directly to each individual institute. Instead, under a scheme made law in last summer's NIH Revitalization Act (C&EN, June 7, 1993, page 5), it will be appropriated as a lump sum to the Office of AIDS Research. That recently expanded office will trans-

Glossary of budget terms

Budget authority. The authority provided by federal law enacted by Congress to incur financial obligations that will result in outlays.

Fiscal year. The fiscal year is the government's accounting period. It begins Oct. 1 and ends Sept. 30 and is designated by the calendar year in which it ends.

Obligations. Binding agreements that will result in outlays, immediately or in the future. Budgetary authority must be available before obligations can be incurred legally.

Outlays. Payments for obligations incurred under Congressionally granted budget authority generally made by issuance of checks on the Treasury. Outlays during any fiscal year may be made for obligations incurred in prior fiscal years or in the same fiscal year.

Note: The R&D numbers supplied by individual agencies frequently differ from those used by the Office of Management & Budget in preparing its analysis of total federal R&D funding.

fer the monies to the individual institutes in accordance with a supposedly comprehensive plan.

NIH's National Center for Human Genome Research would get \$152 million in fiscal 1995, a whopping 18% above this year's spending level. Most of the \$23 million increase is slated for NIH's intramural program, where the center's director, Francis S. Collins, has established a growing laboratory.

The total number of research project grants supported under NIH's proposed budget would decrease slightly in 1995, from 23,985 to 23,891. But the number of new and competing renewal grants would shoot up by more than 1,000 to 7,293. That would be the highest level of new grants ever funded by NIH.

That surprisingly large increase results from an unusual nexus in the normal grant cycle, according to Marvin Cassman, acting director of the National Institute of General Medical Sciences (NIGMS). In the late 1980s, NIH moved toward longer grant periods, averaging close to five years in length. But in 1990, Congress directed the agency to aim for a four-year average, to free up a greater portion of funds each year.

"All the grants we awarded for five years in 1990 plus all the ones we awarded for four years in 1991 will be turning over in 1995," Cassman says. A larger portion of the budget will thus be available for new and competing grants.

NIGMS, the largest single source of chemistry funding within NIH, would receive a 4% budget increase in 1995 to \$907 million. Within NIGMS, funding for the cellular and molecular basis of disease program would increase 4% to \$254 million; the biophysics and physiological sciences program, 4% to \$197 million, including \$25 million for AIDS; and pharmacology and biorelated chemistry, 3% to \$131 million.

"I think we did very well," Cassman says about NIGMS. "You've got to look at the increases in the context of the whole federal government. Given the constraints on the budget, it could have been a lot worse, and it was for a lot of agencies. You are not going to hear me complaining."

Energy. The biggest story in energy research has to be the demise of the Superconducting Super Collider. Funded at \$640 million in fiscal 1994, the Department of Energy (DOE) is asking for only \$180 million next year to continue termina-

NSF's budget is up just 6% overall . . .

\$ Millions	1995 ^a	1994 ^b	1993 ^c	% change 1994-95
Mathematical & physical sciences	\$ 657.7	\$ 619.8	\$ 585.9	6%
Education & human resources	586.0	569.6	505.1	3
Geosciences	443.1	403.9	381.6	10
Biological sciences	313.9	288.8	271.3	9
Engineering	320.4	295.2	256.1	9
Computer & information science & engineering	273.5	240.6	215.6	14
U.S. polar research program & logistics	225.4	220.7	244.2	2
Salaries & expenses	130.7	118.3	110.8	10
Social, behavioral & economic sciences	112.6	98.3	90.7	15
Academic research infrastructure	55.0	100.0	49.8	-45
Major research equipment	70.0	52.0	34.1	35
Other	11.6	10.7	4.7	8
TOTAL	\$3,199.9	\$3,017.9	\$2,749.9	6%

. . . with funding for the 'hard' sciences up 8% . . .

\$ Millions	1995 ^a	1994 ^b	1993 ^c	% change 1994-95
Mathematical & physical sciences	\$ 657.7	\$ 619.8	\$ 585.9	6%
Materials research	185.5	176.1	164.5	5
Physics	141.7	133.7	128.3	6
Chemistry	129.9	121.4	112.3	7
Astronomical sciences	111.9	106.4	103.2	5
Mathematical sciences	88.7	82.2	77.6	8
Geosciences	443.1	403.9	381.6	10
Ocean sciences	207.9	188.9	179.3	10
Atmospheric sciences	147.9	134.4	126.5	10
Earth sciences	87.3	80.6	75.8	8
Biological sciences	313.9	288.8	271.3	9
Molecular & cellular biosciences	91.0	85.1	81.1	7
Integrative biology & neurosciences	83.7	77.9	74.3	7
Environmental biology	83.3	74.8	70.2	11
Biological instrumentation & resources	55.9	51.0	45.7	10
TOTAL	\$1,414.7	\$1,312.5	\$1,238.8	8%

. . . and that for chemical programs up 6%

\$ Millions	1995 ^a	1994 ^b	1993 ^c	% change 1994-95
Materials research	\$185.5	\$176.1	\$164.5	5%
Project support	95.3	88.4	80.5	8
Science & engineering centers	55.3	54.8	51.5	1
National facilities & instrumentation	34.9	32.9	32.5	6
Chemistry	129.9	121.4	112.3	7
Research project support	109.4	102.9	95.6	6
Instrumentation & infrastructure	20.5	18.5	16.7	11
Engineering	61.9	59.2	54.9	5
Chemical & transport systems	38.4	37.1	34.5	4
Fluid, particulate & hydraulic systems	10.2	9.9	9.2	3
Chemical reaction processes	10.2	9.9	9.3	3
Interfacial, transport & separations processes	9.6	9.2	8.6	4
Thermal systems	8.4	8.1	7.4	4
Bioengineering & environmental systems	23.5	22.1	20.4	6
Bioengineering	17.1	16.0	14.6	7
Environmental & ocean systems	6.4	6.1	5.8	5
Biochemistry & molecular structure & function	36.1	33.9	32.7	6
TOTAL	\$413.4	\$390.6	\$364.4	6%

Note: Obligations. a Estimate. b Current plan. c Actual. Source: National Science Foundation

tion of the project. There has been no decision yet on what will be done with the research buildings and facilities already in place at its site in Texas.

That steep, 72%, fall in SSC facility funding allows DOE to hold actual research funding even at \$6.1 billion in a total R&D budget that's down 5% to \$6.6 billion. Some programs would increase—as in high-energy physics, where funding is up 1% to \$622 million; \$140 million is being requested to support university and laboratory-based groups conducting experimental and theoretical research. The department is asking for \$254 million for facility operations and \$58.2 million for improving physics technology.

Basic energy sciences, however, is facing a major budget cut in fiscal 1995. This program has a proposed budget of \$741 million, down \$49.1 million from 1994. Among the individual programs, funding for materials science research is down \$2.8 million to \$274 million; chemical sciences is down \$7 million to \$162 million; engineering and geosciences is down \$1.1 million to \$36.8 million; energy biosciences research is down \$700,000 to \$26 million; and advanced energy projects are down \$300,000 to \$11.1 million. Only funding for applied mathematical sciences would rise, up \$3.2 million to \$109 million.

Robert S. Marianelli, director of the division of chemical sciences in DOE's Office of Basic Energy Sciences, says the division's extramural grants program will remain essentially healthy in fiscal 1995. And support for major research facilities such as the Advanced Light Source at Lawrence Berkeley Laboratory will continue. However, grants to principal investigators at DOE's national labs are being cut back under the division's shrinking budget.

Research and development for the nation's defense programs is part of DOE's responsibility. The 6% drop to \$1.2 billion in the fiscal 1995 budget request for this work reflects the end of the Cold War and changing priorities. This funding level will maintain core research competency at the weapons labs through research on safety and reliability of the weapons stockpile, on dismantling efforts, on nonproliferation, and on pollution prevention studies. The proposed budget also will keep DOE ready to restart underground nuclear testing within six months, if directed to do so by the President.

Marianelli points out that the enormous environmental cleanup problems that DOE faces at its nuclear installations across the country will continue to be a major force shaping the department's budget strategies. DOE has requested a total of \$6.3 billion for environmental management and sees the need for basic re-

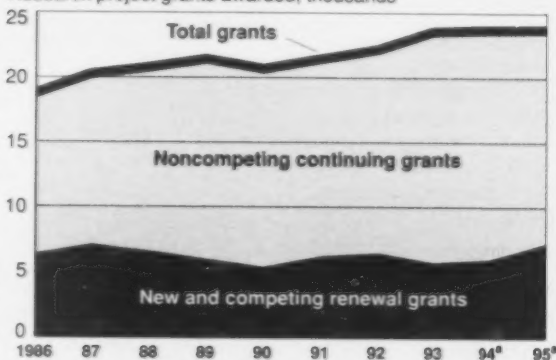
At NIH, R&D at most institutes, including General Medical Sciences, rises only 4%

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
National Institutes	\$10,435	\$10,009	\$ 9,483	4%
Cancer	2,190	2,082	1,978	5
Heart, Lung & Blood	1,325	1,278	1,215	4
Allergy & Infectious Diseases	1,121	1,066	984	5
General Medical Sciences	907	876	832	4
Diabetes & Digestive & Kidney Diseases	743	716	681	4
Neurological Disorders & Stroke	654	631	600	4
Mental Health	638	613	583	4
Child Health & Human Development	581	555	528	5
Drug Abuse	444	425	403	4
Aging	435	420	400	4
Eye	301	290	275	4
Environmental Health Sciences	274	264	251	4
Arthritis & Musculoskeletal & Skin Diseases	231	223	212	4
Alcohol Abuse & Alcoholism	193	186	176	4
Dental Research	176	170	161	4
Deafness & Other Communication Disorders	169	163	155	4
Nursing Research	53	51	49	4
National Center for Research Resources	351	332	313	6
Office of the Director	260	234	192	11
National Center for Human Genome Research	152	129	106	18
National Library of Medicine	139	120	104	16
Other^c	137	133	132	3
TOTAL	\$11,474	\$10,957	\$10,330	5%

^a Estimate. ^b Actual. ^c Includes Fogarty International Center and buildings and facilities.
Source: National Institutes of Health

Number of new NIH grants will reach record high in 1995

Research project grants awarded, thousands



^a Estimates. Source: National Institutes of Health

\$100 million is targeted for replacement of obsolete laboratories in Gaithersburg, Md., and Boulder, Colo.

At the moment, NIST is the Administration's darling among the federal laboratories. Its assignment is to set the pace for ways the government can interact with industry. Its successes, and especially its failures, will be closely watched. More than half of NIST's \$347 million increase will go for its Advanced Technology Program (ATP) and its Manufacturing Extension Partnership (MEP).

Under the budget request, ATP receives \$450 million, money that will be matched by grantees, for its program of funding for various areas of research, development, and technology. Its method is modeled after the Defense Department's Advanced Research Projects Agency (ARPA), which works closely with industry to support development of advanced technologies important to the military. In a word, NIST is ARPA gone civilian.

The other half of the new, externally directed NIST is its MEP, which is asking Congress for \$67.5 million, or \$27.7 million more than in fiscal 1994. MEP is NIST's extension service, as it were, designed to work with state programs to help some of the country's 370,000 small- and medium-sized businesses upgrade their manufacturing processes. The Administration is aiming for a network of 100 manufacturing technology centers by 1997.

NIST has always been best known for its core in-house research work related to key technologies and development of measurement standards. Over the years, the budget for this research has hardly moved. But 1995's \$79 million increase (to \$304 million), plus the \$100 million in construction, will help NIST restore some of the lost ground. Within that, NIST's chemical science and technology laboratory budget increases from \$22.4 million to \$30 million. Funding for materials science and engineering increases from \$45 million to \$60.2 million.

Defense. Most of the requested increases in the Defense Department's research, development, test, and evaluation budget are earmarked for testing and development of weapons systems.

Science and technology programs would increase about 4% to about \$8.1 billion in fiscal 1995, accounting for about 22%

search to address the issues. "When you don't have answers to the problems that face you, you need fundamental research," he says.

National Institute of Standards & Technology. NIST is the biggest winner of all in the fiscal 1995 R&D budget. NIST can be seen as the agency where the Administration's ambitious technology policy is being tested out, and it is undergoing a revolution under its new director, Arati Prabhakar. Where NSF is trying to become more strategic, NIST always has been.

As promised by Clinton in his campaign, NIST's budget has more than doubled from its fiscal 1993 level, rising from \$359 million then, to \$574 million in fiscal 1994, to \$921 million in the fiscal 1995 request. What is significant for NIST is that, for the first time, its extramural spending exceeds its intramural activities—\$517 million to \$304 million. Another

of Defense's total R&D request. Of this, \$3.0 billion is for exploratory development, \$3.9 billion for advanced development, and about \$1.2 billion for basic research. These numbers do not include the Ballistic Missile Defense Office, formerly the Star Wars defense program, which is requesting nearly \$3.0 billion, a \$363 million increase.

One Defense agency getting increased funding across all areas is ARPA. Funded at nearly \$2.6 billion in fiscal 1994, the Administration is seeking a \$100 million increase for fiscal 1995. Other defense offices receiving significant R&D increases are the Defense Logistics Agency and the Defense Mapping Agency, where the increases are likely to go to modernizing computer systems and information technology.

The Defense Department is also paying close attention to the link between the military and economic components of the nation's security. In that light, it is allocating \$2.1 billion for development of dual-use technologies—those that have both military and civilian applications—in fiscal 1995. Portions of the dual-use program include reinvestment initiatives to boost R&D of critical dual-use technologies, as well as efforts to commercialize these technologies.

Also, Defense will set up programs to assist small manufacturers in upgrading their capabilities to meet commercial and defense needs, and it plans electronics and materials initiatives to support industry research for technologies ranging from high-definition computer systems to composite materials manufacturing.

As at other agencies, the environment is becoming a major focus of research at the Defense Department. For example, the Pentagon has directed the Air Force Office of Scien-

Energy research budgets continue to slip

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
ENERGY R&D	\$5,455.3	\$5,734.9	\$4,987.3	-5%
General science & research	1,113.1	1,615.1	1,406.3	-32
High-energy physics	621.9	617.5	587.6	1
Nuclear physics	300.8	348.6	297.6	-14
Superconducting Super Collider	180.0	640.0	512.9	-72
General science direction	10.4	9.0	8.2	10
Supporting research & technical analysis	910.3	934.9	883.8	-25
Environmental restoration & waste management	744.0	709.1	673.1	5
Conservation	610.8	414.6	300.2	47
Fossil	485.8	481.6	441.7	1
Biological, environmental	434.8	416.4	334.0	4
Solar	392.7	340.8	239.8	15
Fusion	372.6	342.9	317.9	9
Nuclear fission	231.9	319.7	239.8	-28
Environmental health	149.3	159.8	150.7	-7
DEFENSE R&D	1,187.8	1,266.5	1,446.4	-6
TOTAL	\$6,633.1	\$7,001.1	\$6,433.7	-5%

Note: Obligations. a Estimate b Actual Source: Office of Management & Budget

NIST is major beneficiary of budget's technology emphasis

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
Industrial technology services	\$517.3	\$287.4	\$ 75.2	80%
Advanced technology program	449.8	247.6	61.0	82
Technology transfer & outreach	67.5	39.8	14.2	70
Measurement & engineering research & standards	303.9	224.8	182.0	35
Computer systems	63.2	28.0	12.1	126
Materials science & engineering	60.2	45.0	37.3	34
Electronics & electrical engineering	30.0	29.8	24.8	1
Chemical science & technology	30.0	22.4	19.8	34
Manufacturing engineering	29.5	13.4	10.0	120
Research support activities	28.2	27.6	24.3	2
Physics	27.7	27.2	25.7	2
Technology assistance	14.5	11.1	9.5	31
Building & fire research	13.3	13.2	11.8	1
Applied mathematics & scientific computing	7.3	7.1	6.7	3
Research facilities	100.0	61.7	102.0	62
TOTAL	\$921.2	\$573.9	\$359.2	61%

Note: Obligations. a Estimate b Actual Source: Office of Management & Budget

tific Research (AFOSR) to emphasize studies on environmental remediation and on nonpolluting materials and processes, according to AFOSR's Charles Yee.

Yee, polymer chemistry program director in the Chemistry & Materials Science Directorate's chemistry division, says the environmental emphasis has necessitated cutbacks in other areas. For instance, the electrochemistry program will be eliminated entirely under AFOSR's proposed 1995 budget.

The Office of Naval Research (ONR) is undergoing a major reorganization to add technology to its mission, says Harold E. Guard, who manages programs in inorganic and organic chemistry there. "ONR used to be the Navy's office for the support of basic research through grants and contracts and the Naval Research Laboratory," he says. "There was a separate office for technology development. Now we are combined in one office meant to integrate science and technology."

Guard says ONR is essentially in chaos as it plans new directions for its technical programs. "My gut feeling is that we are under incredible pressure to move more to applied research," he says.

Such a focus on the eventual applications of research has been the norm at the Army Research Office, according to Robert W. Shaw, who heads ARO's chemical kinetics program. He says he expects the Army to keep funding for basic research stable, even while it is cutting back in other areas.

"All along, we have had to justify what we are doing in terms of its eventual benefits," Shaw says. "But we will be making more of an effort to communicate what we do to Army scientists and engineers who are our ultimate customers."

Continued on page 28

Defense R&D is up 4% after 1994 dip

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
Operational systems development	\$10,869	\$11,474	\$10,586	-5%
Engineering & manufacturing development	8,916	7,441	8,487	20
Advanced development	5,117	6,115	6,282	-16
Demonstration & validation	3,771	2,698	4,212	40
R&D, test & evaluation management support	3,343	3,218	3,398	4
Exploratory development	2,984	2,743	3,549	9
Basic research	1,225	1,205	1,314	2
TOTAL	\$36,225	\$34,894	\$37,828	4%

Note: Obligations. ^a Estimate. ^b Actual. Source: Department of Defense

Environmental Protection Agency. During the first two decades of its existence, EPA spent most of its R&D budget on finding solutions to problems in specific media, such as air or water. In 1993, that emphasis began to change, and now in fiscal 1995, multimedia research is slated to claim nearly half the R&D budget. It also will receive the greatest increase, 29% over appropriations for 1994, to \$272 million. A large part of this funding, \$80 million, will go to the President's Environmental Technology Initiative, which provides federal assistance to private-sector development of innovative environmental technologies.

The National Human Exposure Assessment Survey, which measures toxic substances accumulated in human tissue, and the interagency research program of the National Science & Technology Council, which includes advanced manufacturing and high-performance computing, will also receive higher funding than in 1994. The U.S.-Mexico Border Project, a new program established under the North American Free Trade Agreement, will focus on environmental and exposure monitoring of populations that are subject to the greatest potential health risk from pollutants near the border.

Research on issues involved in implementing the Clean Air Act accounts for the second largest portion of EPA's 1995 R&D budget, about \$116 million, a 9% decrease from 1994. Included in this figure are resources to study global climate change, stratospheric ozone depletion, health effects of air toxics, motor vehicle pollution, and indoor air pollution. Acid deposition monitoring will be performed under a different program, the Ecological Monitoring & Assessment Program. The remainder of the acid rain research program will be eliminated. Global climate change research will focus on assessment and mitigation of activities that increase the atmospheric levels of greenhouse gases.

Research related to Superfund will also receive less funding than in 1994, about \$61 million, a decrease of 4%. Under this program, EPA will focus on watersheds and ecological risk assessment associated with Superfund sites. Ground-water research under Superfund will be directed toward means of removing non-water-soluble liquids from underground soil and fractured rock.

Construction cuts hurt USDA research

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
Federal agricultural research programs	\$ 708.6	\$ 691.6	\$ 668.0	2%
Partnership education programs	432.7	436.2	427.2	-1
Partnership research & academic programs	421.4	456.6	433.0	-8
Research facility construction	25.7	89.6	86.6	-71
National Agricultural Library	19.7	18.3	17.7	8
TOTAL	\$1,608.1	\$1,692.3	\$1,692.5	-5%

Note: Obligations. ^a Estimate. ^b Actual. Source: Department of Agriculture

At EPA, only multimedia and pesticide research post gains

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
Multimedia	\$272.0	\$211.5	\$164.1	29%
Air	116.3	127.7	127.8	-9
Superfund	61.4	63.7	64.8	-4%
Hazardous waste	28.6	32.0	40.5	-11
Water quality	25.2	29.3	29.8	-14
Toxic substances	23.0	25.2	24.7	-9%
Drinking water	18.8	19.5	19.3	-4
Pesticides	15.6	14.3	14.3	9
Management & support	6.7	6.5	5.9	3
Oil spills	2.1	2.1	na	0
Leaking underground storage tanks	0.8	0.8	0.7	0
TOTAL	\$570.5	\$532.6	\$491.9	7%

Note: Obligations. ^a Estimate. ^b Actual. na = not available. Source: Environmental Protection Agency

Efforts aimed at protecting ecosystems, an integral part of many different R&D programs, also will receive increased funding. These efforts include environmental monitoring and risk assessment.

In nearly every R&D program, some of the research that has been performed by contractors over the past few years will be done by EPA staff in fiscal year 1995. However, some of EPA's in-house research efforts are also being cut back. For example, the Arctic research program that is run out of the EPA lab in Corvallis, Ore., is being almost totally shut down, and the lab's ecotoxicology program is being eliminated. Staffers who worked on this program will now be taking an ecosystem rather than a toxicological approach to environmental problems in the Pacific Northwest.

Agriculture. The budget proposal lays out major changes for agricultural research. The Clinton Administration wants to combine all of the Department of Agriculture's several research agencies into one entity.

NASA's overall budget is down, but support for R&D increases a little

\$ Millions	1995 ^a	1994 ^a	1993 ^b	% change 1994-95
Science, aeronautics & technology	\$ 5,901	\$ 5,847	na	1%
Space science	1,766	1,722	\$ 1,563	3
Mission to Planet Earth	1,238	1,024	1,132	21
Aeronautical research & technology	899	1,102	858	-18
Advanced concepts & technology	608	495	na	23
Missions communication services	481	589	na	-18
Life & microgravity science & applications	471	515	na	-9
Launch services	341	314	na	9
Academic programs	97	86	79	13
Human space flight	5,720	6,070	na	-6%
Space shuttle	3,324	3,549	na	-6
Space station	1,890	1,937	2,051	-2
Payload & utilization operations	356	413	na	-14
U.S.-Russian cooperation	150	171	na	-12
Mission support	2,663	2,619	na	2
Inspector General	16	15	15	7
TOTAL	\$14,300	\$14,551	\$14,294	-2%

Note: Because of major restructuring in the National Aeronautics & Space Administration's budget accounts, many line items for fiscal 1993 are not available and those that are may not be entirely comparable with fiscal 1994 and 1995. ^a Estimate. ^b Actual. **na** = not available. **Source:** Office of Management & Budget.

Under the plan, the existing Agricultural Research Service, Cooperative State Research Service, Extension Service, and National Agricultural Library will become the Agricultural Research & Education Service. According to USDA, this change would lead to improved coordination of intramural and extramural research programs and enhance delivery of new technology to the states.

But the reorganization doesn't mean more money. Overall, R&D funding at agriculture is essentially flat. Small gains in a variety of areas are outweighed by a 71% drop to \$25.7 million in funding for building and facilities construction. Facilities funding under the Partnership Research & Academic Program (equivalent to the old Cooperative State Research Service) falls from \$56.9 million in fiscal 1994 to zero next year. The Administration also plans a \$7 million cut in construction funds for federal agricultural labs, from \$32.7 million in fiscal 1994. This 21% cut comes despite admissions that major federal research facilities are functionally obsolete and in need of major modernization.

However, the budget does call for an increase of \$17.8 million to \$130 million for the National Research Initiative, which funds the only peer-reviewed grants USDA gives out. Funds for other parts of the program, which funds research in cooperation with state experimental stations and institutions, are frozen in the budget. For example, funds for the support of the traditionally black colleges under the 1890 Colleges and Tuskegee Formula, would total \$28.2 million in fiscal 1995, the same as this year.

And a budget drop of \$43.2 million is requested in the special research grant category, which funds researchers at many institutions. The Administration says it has cut out a number of Congressionally earmarked projects in this category and is seeking just \$29.7 million in new funding.

For Federal Agricultural Research Programs (the old Agricultural Research Service), funding would rise 2% to \$709 million. Major increases occur in the area of commodity conversion and delivery, which focuses on food safety concerns. This program is slated to receive \$157 million in fiscal 1995, up \$18.4 million. A proposed \$10 million increase would fund research on alternatives to methyl bromide use in soil fumigation and quarantine treatments. Another high-priority research area is the reduction of pathogens in meat and poultry products.

National Aeronautics & Space Administration. This winter, NASA has been celebrating the triumph of its astronauts successfully correcting the Hubble Space Telescope's myopic vision. But the 1995 budget request for the agency is more in line with the unnerving string of failures that the agency had been experiencing: The President has proposed cutting NASA's budget 2% to \$14.3 billion.

"This is not the usual good news-bad news budget for NASA," says Rep. Brown. "It's a case of bad news-worse news. The [proposed] budget is too low to support the vigorous space program envisioned by the Administration and by NASA."

Budgets for both the space shuttle and the space station, contained in the human space flight category, would be cut relative to this year. The same category would provide \$150 million for collaborative projects with Russia. The funds would go, in part, to payments on a four-year contract with the Russian Space Agency for NASA's lease of the Russian Mir space station.

One of the few NASA programs to receive an increase would be Mission to Planet Earth, up 21% to \$1.2 billion. The program is the centerpiece of the federal interagency global-change research program. Mission to Planet Earth employs satellite, aircraft, and ground-based instruments to observe and monitor large-scale environmental processes. The goal of the program is to provide policymakers the data they need to deal with global issues such as climate change.

More than one third of Mission to Planet Earth's 1995 funding, \$455 million, would go to the Earth Observing System (EOS). EOS consists of a series of satellites, scheduled to begin launching in 1998, that will monitor many processes on Earth simultaneously. The budget also contains funds for smaller satellites called Earth Probes that will study tropical rainfall, ocean winds, and global ozone.

Funding for NASA's aeronautical research and technology programs would drop 18% overall in fiscal 1995 to \$899 million. But the high-speed aircraft research program, which NASA describes as its highest priority research effort, would increase 12% to \$221 million. The program's goal is to develop an economically viable, environmentally safe supersonic aircraft. The 1995 budget would continue funding for atmospheric chemists' ongoing assessment of the effects of the proposed planes' exhaust on the ozone layer.

As Brown cautions in his committee's analysis of the overall R&D budget, the President's budget request does not often translate into appropriated dollars. Almost all of the final research appropriations came in below requested funding levels in fiscal 1994. According to Brown, the same thing is likely to happen again this year. □